CLAIMS

1. Device for measuring the sedimentation rate in biological fluids, and especially the rate of erythrocyte sedimentation in blood samples, comprising: holders for test tubes containing samples of biological fluids; agitator devices for agitating said test tubes; at least one detector for detecting the levels inside said test tubes; characterized in that said holders are formed in a continuous flexible member defining a closed path, along which said agitator devices and said at least one detector are arranged.

2. Device as in claim 1, characterized in that the following are arranged along said closed path: at least one agitating area, wherein said agitator devices are provided; at least one sedimentation area; and at least one reading area wherein said detector is installed.

3. Device as in claim 1 or 2, characterized in that said flexible member defines a path lying on a substantially horizontal plane.

4. Device as in claims 1 or 2 or 3, characterized in that said holders are composed of elements interconnected to form a flexible chain member.

5. Device as in claim 4, characterized in that each of said elements comprises a single seat for a respective test tube.

6. Device as in claim 4 or 5, characterized in that the elements forming said flexible member are connected together by means of couplings that enable consecutive elements to rotate with respect to each other so as to make single elements depart from the plane on which the flexible member lies.

7. Device as in claim 6, characterized in that said couplings are composed of spherical joints.

8. Device as in one or more of the previous claims, characterized in that said agitator devices are arranged and made to induce the oscillation of said holders.

9. Device as in claims 4 and 8, characterized in that said agitator devices are made and arranged to induce the oscillation of said elements forming the flexible chain member, outside the plane on which the flexible member lies.

10. Device as in claim 9, characterized in that said agitator devices include guides in which the elements forming said continuous flexible chain member are engaged, thereby causing the oscillation of said elements.

11. Device as in claim 10, characterized in that said elements have sliding shoes engaging in said guides.

12. Device as in claim 9, 10 or 11, characterized in that said agitator devices include fixed guides, extending along a portion of the path covered by said flexible member, that are made and arranged so that the elements moving along them are forced to oscillate outside the plane on which said continuous flexible member lies.

13. Device as in claim 9, 10 or 11, characterized in that said agitator devices include mobile guides, extending along a portion of the path covered by said flexible member, wherein said elements forming the flexible member are engaged, said guides being made and arranged to induce, with their motion, an oscillation of the elements attached thereto outside the plane on which the continuous flexible member lies.

14. Device as in one or more of the claims 9, 10, 11 and 13, characterized in that said agitator devices comprise a rotor coaxial to a stretch of the path of said flexible member and provided with elements for engaging the holders that come to be along said stretch along the path of the flexible member, said rotor being capable of a rotating or oscillating movement around its own axis.

15. Device as in claim 14, characterized in that said engaging elements are in the form of guides within which said holders forming the continuous flexible member are slidingly engaged.

16. Device as in one or more of the previous claims, characterized in that a first detector is arranged along said closed path, downstream from the agitator devices, and at least one second detector is arranged further along said path, downstream from a portion of path defining a first sedimentation area.

17. Device as in claim 16, characterized by a third detector arranged along said path, downstream from a further portion of path defining a second sedimentation area.

18. Device as in one or more of the previous claims, characterized in that said continuous flexible member comprises a transponder associated with each test-tube holder.

19. Device as in claims 4 and 18, characterized in that each of said elements is associated with a respective transponder.

20. Device as in claim 18 or 19, characterized in that along said path there are one or more stations for scanning said transponders.

21. Device as in one or more of the previous claims, characterized in that along said closed path there is at least one extractor, for removing the test tubes from said holders.

22. Device as in claim 21, characterized in that along said closed path there are two extractors for removing the test tubes from said holders and distributing them in respective containers.

23. Device as in one or more of the previous claims, characterized in that automatic manipulators are provided for automatically inserting the test tubes in said holders.

24. Device as in claim 23, characterized in that said manipulators are arranged and made to collect single test tubes from a rack of test tubes and to insert said test tubes in said holders.

25. Device as in one or more of the previous claims, characterized in that it includes a setup unit for preparing the test tubes for insertion in said holders.

26. Device as in claim 25, characterized in that said setup unit is situated above said continuous flexible member.

27. Device as in claim 25 or 26, characterized in that said setup unit comprises a reading station for automatically reading labels attached to said test tubes, to ascertain in each case whether they must undergo a measurement of the sedimentation rate of the sample contained therein.

28. Device as in claims 24 and 27, characterized in that said manipulators are controlled and operated by a central unit as a function of information provided for each test tube by said reading stations, to transfer the test tubes in which the sedimentation rate must be measured from the rack to a corresponding holder.

29. Device as in one or more of the claims 25 to 28, characterized in that said setup unit comprises at least one first conveyor for moving a plurality of racks containing test tubes with samples of biological fluid to analyze.

30. Device as in claims 27 and 29, characterized in that said setup unit comprises a first transfer unit for removing single racks from said first conveyor and transferring them to said reading station.

31. Device as in one or more of the claims 24 to 30, characterized in that said manipulators include a lower push bar coming to bear on the test tubes contained in the racks in order to slide said test tubes partially out of said racks, and a mobile clamp for removing the test tubes from the respective racks and inserting them in corresponding holders in the continuous flexible member.

32. Device as in claim 29 at least, characterized in that the setup unit includes a second conveyor for moving a plurality of racks and a second transfer device for transferring the racks from the second to the first of said conveyors.

33. Device as in claim 32, characterized in that the first transfer device transfers the racks from the first conveyor to the reading station and from there to the second conveyor.

34. Device as in one or more of the claims 29 to 33, characterized in that means for identifying the status of each rack are associated with at least one of said first and/or second conveyors of the setup unit.

35. Method for measuring the sedimentation rate in biological fluids, and the rate of erythrocyte sedimentation in blood samples in particular, comprising: a phase in which biological fluids contained in test tubes are agitated; a sample sedimentation phase; and a phase for reading the level of the sediment inside said test tubes; <u>characterized in that:</u> said test tubes are placed in respective holders forming a continuous flexible member; said continuous flexible member is advanced along a closed path; and the single test tubes go through said agitation, sedimentation and reading phases in areas sequentially arranged along said closed path.

36. Method as in claim 35, characterized in that said test tubes are agitated by rotating said holders in relation to each other around a

substantially horizontal axis.

37. Method as in claim 35 or 36, characterized in that, along said path, two readings are taken on the biological samples in each test tube, the first when it leaves the agitation area and the second at the end of the sedimentation area.

38. Method as in claim 37, characterized in that, after the reading of the level of sediment, said samples undergo a second sedimentation phase and a further reading of the level of sediment after said second sedimentation phase.

39. Method as in one or more of the claims 35 to 38, characterized in that said test tubes are test tubes for complete blood counts.

40. Method as in claim 39, characterized in that: said test tubes are sequentially fed to a station for reading the labels attached to said test tubes; for each test tube, it is ascertained whether the sample contained therein is to undergo a sedimentation rate measurement; the test tubes in which the sedimentation rate is to be measured are transferred to said holders.

41. Method for measuring the erythrocyte sedimentation rate (ESR), wherein a blood sample is placed in a generic test tube, such as a test tube for CBC, <u>characterized in that</u> said sample is kept in said test tube for a predetermined time and the erythrocyte sedimentation rate is recorded by an automatic reading system that reads the blood sample directly inside said test tube.

42. Method as in claim 41, wherein a plurality of test tubes are inserted in a rack and wherein said reading is taken on one or more test tubes without removing the test tubes from the rack that contains them.

43. Method as in claim 41 or 42, wherein a detection system is used to ascertain whether said test tube contains a sample on which the erythrocyte sedimentation rate needs to be analyzed and wherein, if the outcome of said check is positive the ESR is measured, if not consent is given for the processing of the next test tube.

44. Method as in claim 43, wherein said detection system coincides with the erythrocyte sedimentation rate reading system.

45. Method as in claim 43, wherein the detection system is separate

from the erythrocyte sedimentation rate reading system.

46. Method for performing analyses on the erythrocyte sedimentation rate of a blood sample contained in a test tube, wherein: said sample is agitated and subsequently kept in said test tube for a predetermined time; the type of test tube containing said sample is recorded by an automatic detection system; and the erythrocyte sedimentation rate is measured by an automatic reading system, the detected value being processed as a function of the type of test tube containing the sample.

47. Method as in claim 46, wherein the value detected is modified by means of a correlation algorithm if said test tube is not a test tube specifically for erythrocyte sedimentation rate analyses.

48. Method as in claim 46 or 47, wherein said automatic reading system identifies the type of test tube wherein said sample is contained.

49. Method as in claim 46, 47 or 48, wherein a detection system is used to ascertain whether said test tube contains a sample in which the erythrocyte sedimentation rate is to be measured.

50. Method as in claim 49, wherein the detection system coincides with the system for reading the erythrocyte sedimentation rate.

51. Method as in claim 49, wherein said detection system and said erythrocyte sedimentation rate reading system are separate.

52. Method as in one or more of the claims 46 to 51, wherein a plurality of test tubes are inserted in a rack and the erythrocyte sedimentation rate is measured without extracting the test tubes from the rack.

53. Method as in one or more of claims 41 to 52, wherein a plurality of test tubes are inserted in a rack and analyzed in series.

54. A device for measuring the erythrocyte sedimentation rate (ESR) of blood samples contained in test tubes, comprising a control unit and a system for reading the test tubes containing the blood samples on which to perform said analyses, characterized in that said reading system takes the reading of the sample inside the respective test tube regardless of the type of test tube wherein it is contained, without extracting the sample from said test tube.

55. Device as in claim 54, comprising means for moving the racks

containing the test tubes in which to measure the erythrocyte sedimentation rate, said reading system and said means of movement being made and arranged so that the reading of the erythrocyte sedimentation rate can be taken without extracting the test tube from the rack.

56. Device as in claim 54 or 55, wherein said control unit includes detection means that automatically recognizes the type of test tube containing the samples.

57. Device as in claim 56, wherein said control unit corrects the measurement taken by said reading system as a function of the type of test tube containing the sample.

58. Device as in claim 56 or 57, wherein said detection means comprises the reading system or a part thereof.

59. Device as in claim 56 or 57, wherein said detection means comprises a system for interrogating a transponder associated with the test tubes containing the samples.

60. Device as in one or more of the claims 54 to 59, wherein said reading system comprises a video camera.

61. Device as in claim 60, wherein said video camera reads both a machine-readable code associated with said test tube and the content of the test tube to determine the erythrocyte sedimentation rate.

62. Device as in one or more of the claims 54 to 59, wherein said reading system comprises a capacitive sensor.

63. Device as in one or more of the claims 54 to 59, wherein said reading system comprises an ultrasound sensor.

Device as in one or more of the claims 54 a 59, wherein said reading system comprises an infrared sensor.

64. Device as in one or more of the claims 54 to 63, wherein said reading system comprises a reader of a machine-readable code.

65. Device as in one or more of the claims 54 to 64, comprising a mechanism for turning the test tubes containing the samples to analyze in order to orient said test tubes correctly with respect to the reader system.

66. Device as in claim 65, wherein said control unit is interfaced with said rotating mechanism and governs said rotation mechanism so as to orient

the test tubes to enable the reading of a machine-readable code attached thereto and the subsequent analysis of the erythrocyte sedimentation rate.

67. Device as in one or more of the claims 54 to 65, comprising a magazine for holding and agitating a plurality of test tubes, a sedimentation area and a test-tube reading area, wherein said reading system is installed.

68. Device as in claim 67, wherein said magazine comprises means for holding racks of various types in which the test tubes are contained.

69. Device as in claim 67 or 68, wherein said magazine comprises a first flexible conveyor with associated seats for engaging and retaining different types of rack containing said test tubes.

70. Device as in claim 69, wherein said first conveyor is realized and arranged to make said seats transit sequentially: in a position for loading the racks, in a position for transferring the racks to the sedimentation area, in a position for receiving the racks from the reading area and in a position for ejecting the racks.

71. Device as in claim 69 or 70, wherein said first conveyor moves along a closed path lying on a substantially vertical plane.

72. Device as in one or more of the claims 67 to 71, wherein said magazine is associated with a tray for supporting the racks of test tubes and a plunger for individually inserting racks of test tubes in said magazine.

73. Device as in one or more of the claims 67 to 72, wherein there is a second flexible conveyor in said sedimentation area, provided with a plurality of seats for said racks.

74. Device as in claim 73, wherein said second conveyor has a stretch of straight and substantially horizontal path, extending between a position for receiving the racks from said magazine and a position for reading the test tubes.

75. Device as in claim 74, wherein there is a number of seats for said racks along the stretch of straight and substantially horizontal path of said second conveyor such that, multiplied by the number of test tubes per rack and by the time it takes to read each test tube, gives rise to the sedimentation time required for the samples before the erythrocyte sedimentation rate is detected.

76. Device as in one or more of the claims 67 to 75, wherein said magazine is arranged alongside said sedimentation area and said reading area, where thrust means transfer the racks from the magazine directly to the sedimentation area and from the reading area directly to the magazine.